

**REMARKS**

Upon entry of the present amendment, claims 2, 3, 5-8, 10, 11, 13-15, 17, 18 and 20 will be canceled without prejudice or disclaimer of the subject matter recited therein; and claims 1, 9 and 12 will be amended. Claims 1, 4, 9, 12, 16 and 19 will remain pending, with claim 1 being the sole independent claim.

Claim 1 has been amended herein without expressing agreement and/or acquiescence with the rejections of record, and is merely being made in an attempt to advance the present application to allowance. In particular, the amendment herein is made to include subject matter recited in dependent claims, such as dependent claim 7 into independent claim 1. Additionally, claims 9 and 12 have been amended herein in accordance with the Examiner's suggestion in the 35 U.S.C. 112, second paragraph, rejection.

Entry of this amendment after final rejection is appropriate in view of the fact that new issues and the necessity for a new search should not be raised. In particular, subject matter recited in the amended claims has previously been considered, and the amendment presented herein is merely reducing issues for allowance of the application or appeal.

Reconsideration of the rejections of record, and allowance of the application in view of the following remarks are respectfully requested.

**Response To Rejection Under 35 U.S.C. 112, Second Paragraph**

Claims 9-15 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite because the examiner contends that the Mg in claims 9-15 should be amended to "elemental Mg".

In response, Applicants note that the currently pending claims 9 and 12 have been amended to more explicitly recite "elemental Mg". Accordingly, this ground of rejection should be withdrawn.

#### **Response to Rejection Under 35 U.S.C. 103(a)**

The following rejection is set forth in the Final Office Action.

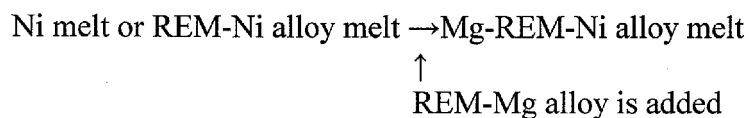
Claims 1-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over JP 2001-226722 (hereinafter "JP '722").

In response, Applicants note that independent claim 1 is directed to a method of producing a Mg-REM-Ni based hydrogen-absorbing alloy, comprising a first step of melting a rare earth element starting material having a low evaporation pressure and a nickel starting material in a melting furnace to obtain a melt of REM-Ni alloy; a second step of adding magnesium starting material to the melt of REM-Ni alloy wherein the temperature of the melt of REM-Ni alloy at the addition of the magnesium starting material is 1250-1400°C, the magnesium starting material comprising elemental Mg or Mg<sub>2</sub>Ni, and keeping a pressure inside the melting furnace after the addition of the magnesium starting material at a pressure of 350-500 Torr to obtain a melt of Mg-REM-Ni alloy; and a third step of cooling and solidifying the melt of Mg-REM-Ni alloy at a given cooling rate.

Applicants once again submit that there is no reason to arrive at Applicants' claimed subject matter, especially in view of the negative teachings of JP '722. JP '722 discloses a method of melting in paragraph [0016] wherein a rare earth-Mg system alloy is prepared first, which is supplied to nickel molten metal or a rare earth-nickel alloy molten metal, and the hydrogen storing metal alloy of a requested presentation is prepared. Moreover, claim 1 of JP

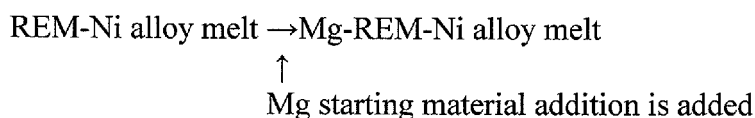
'722 includes that a rare earth-magnesium-nickel alloy of the requested presentation is prepared by adding a rare earth-magnesium alloy to the nickel melt or rare earth-nickel alloy.

As previously pointed out by Applicants, the method disclosed by JP '722 is simply illustrated as follows.



To the contrary, the melting method of the present invention, as recited in independent claim 1, is directed to a method of obtaining a Mg-REM-Ni alloy melt by melting a rare earth element starting material and a nickel starting material in a melting furnace to obtain a melt of REM-Ni alloy at a first step, then adding a magnesium starting material comprising Mg or Mg<sub>2</sub>Ni to the melt of REM-Ni alloy at a second step, and at the same time keeping pressure inside the melting furnace at a given level of 350-500 Torr.

This is simply illustrated as follows.



In other words, the melting method of JP '722 is a technique of manufacturing a REM-Mg system alloy having a low melting point (600-1000°C) in advance, using it as an additional starting material to lower the temperature of a REM-Ni series alloy melt and control composition change caused by evaporation of Mg, and thus obtaining a Mg-REM-Ni alloy of the requested composition.

JP '722 is directed to a technique of controlling evaporation of Mg by using Mg-REM of lower melting temperature as a starting material, while the presently claimed subject matter is

directed to a technique of preventing the evaporation of Mg by adjusting pressure to be in an appropriate range inside a furnace when melting alloy and by controlling melting temperature. Thus, Applicants' claim 1 includes a first step of melting a rare earth element starting material having a low evaporation pressure and a nickel starting material in a melting furnace to obtain a melt of REM-Ni alloy; a second step of adding magnesium starting material to the melt of REM-Ni alloy wherein the temperature of the melt of REM-Ni alloy at the addition of the magnesium starting material is 1250-1400°C, the magnesium starting material comprising elemental Mg or  $Mg_2Ni$ , and keeping a pressure inside the melting furnace after the addition of the magnesium starting material at a pressure of 350-500 Torr to obtain a melt of Mg-REM-Ni alloy; and a third step of cooling and solidifying the melt of Mg-REM-Ni alloy at a given cooling rate. Certainly, this combination of process steps is not taught or suggested by JP '722 which is directed to a fundamentally different process including its manner of preventing evaporation of Mg.

The present invention discloses the technique of melting REM starting material and Ni starting material to obtain REM-Ni alloy melt, adding Mg starting material comprising Mg or  $Mg_2Ni$ , further setting the alloy melting temperature at the time of Mg starting material being added as the appropriate range, controlling the pressure in the melting furnace after Mg starting material is added so that the alloy melting temperature could be controlled in the appropriate range and that the evaporation of Mg could be inhibited, and thus obtaining the desired Mg-REM-Ni alloy.

With respect to the above, the Examiner's attention is directed to, for example, Applicants' specification at page 7, first two full paragraphs, wherein it is disclosed that:

In this case, the temperature of the melt is required to be kept within the above temperature range even after the addition of the magnesium starting material. However, the inside of the furnace after the addition of Mg is filled with the Mg vapor, so that it is very difficult to visually confirm the temperature of the melt

by inserting a thermocouple or the like into the melt. In the invention, therefore, the pressure inside the melting furnace is controlled instead that the temperature inside the melting furnace is kept within the above temperature range to provide substantially the same melting condition as in the temperature range.

Moreover, FIG. 1 is a graph showing a relation between the pressure inside the melting furnace and the temperature of the melt. That is, when the pressure inside the furnace is controlled by an output load of the melting furnace for controlling the temperature of the melt to the above range, the temperature of the melting atmosphere can be naturally controlled to the above range, which renders the control of accurate magnesium composition. In this case, the pressure inside the furnace corresponding to the temperature range is 350-500 Torr as seen from FIG. 1.

Japan '722 does not disclose a second step of adding magnesium starting material comprising Mg or  $Mg_2Ni$  to the melt of REM-Ni alloy and keeping a pressure inside the melting furnace at a given level to obtain a melt of Mg-REM-Ni alloy.

Furthermore, the present invention discloses the method of obtaining the desired compound alloy of high precision by melting Mg having high vapor pressure and a metal having a higher melting point than Mg. In contrast, JP '722 includes the premise that the corresponding alloy, i.e., REM-Mg alloy, already exists and does not provide disclosure how to obtain this alloy.

The Examiner attempts to arrive at Applicants' claimed subject matter by contending that JP '722 discloses (referencing paragraphs [0006] and [0007] of JP '722) that it is known on the art to use Mg metal as the magnesium starting material. However, JP '722 teaches that it is not preferable to add Mg metal directly to an elevated temperature molten metal because a large amount of Mg will evaporate. Therefore, the rejection contends that it would have been obvious to one of ordinary skill in the art to use the known magnesium starting material of Mg in the method of JP '722 with the expectation of a large amount of Mg or  $Mg_2Ni$  evaporation.

However, the disclosure of JP '722 teaches away from Applicants' claimed method and, in fact, specifically discloses problems with adding Mg metal directly to an elevated temperature molten metal and provides it method for avoiding adding a rare earth-magnesium system hardener to a nickel molten metal or a rare earth-nickel series molten metal.

Emphasizing the above, Applicants note that JP '722 discloses in Paragraphs [0006] and [0007] that "Mg metal cannot be directly added to a high temperature melt when producing a hydrogen absorbing alloy mainly composed by Mg, Ni and rare earth element" and that "there is a problem in the conventional method of producing a hydrogen absorbing alloy mainly composed by Mg, Ni and rare earth element, which requires to set the melting temperature high because of using Mg-Ni alloy of a high melting point as an alloy material, causes not only a poorer productivity in the mass production but also a huge composition variation in the alloy by Mg's vaporization and makes the alloy composition control more difficult compared to the case of using LaNi<sub>5</sub> alloy". Due to the above, JP '722 further describes that Mg metal and Mg-Ni alloy cannot be used as a material of the hydrogen absorbing alloy mainly composed by Mg, Ni and the rare earth element.

Further, the invention of JP' 722 has the same purpose of the invention of the application in terms of trying to prevent the alloy composition variation. However, in the invention of JP'722, "rare earth-Mg alloy of a low melting point" is prepared instead of Mg metal and Mg-Ni alloy in order to solve the above problem and the alloy is added to "the melt of Ni" or "the melt of rare earth-Ni alloy" to produce the hydrogen absorbing alloy of the desired composition (see J P '722 Paragraph [0016]). In other words, the invention of JP'722 clearly eliminated the option of using Mg-metal and Mg-Ni alloy as a material due to the above problem.

In contrast, the invention of the application is a technique of using Mg metal or Mg<sub>2</sub>Ni as Mg starting material which the invention of JP'722 eliminated and is completely different from that of JP'722. That is, Applicants found that Mg's vaporization from the melt of Mg-REM-Ni alloy can be prevented by setting the melting temperature of 1250 - 1400 °C. However, when Mg starting material is added to the melt of REM-Ni alloy of the temperature being set at 1250 - 1400°C, the accurate temperature cannot be measured due to the melting temperature deviation caused by the generated Mg vapor. Therefore, the invention of the application focused on the correlation between the inner furnace's pressure and the melting temperature and proposed the technique of obtaining REM-Ni-Mg alloy of the desired composition by controlling the inner furnace's pressure in order to indirectly and accurately control the melting temperature after adding Mg starting material to the melt and preventing the composition variation caused by Mg's vaporization.

The Paragraphs [0041] and [0049] of JP'722 describe that the temperature of the melt of Ni-REM alloy is lowered before Mg starting material (REM-Mg alloy) is added, however, there is no mentioning of the temperature control after Mg starting material is added. Furthermore, there is no suggestion of controlling the inner furnace's pressure.

Therefore, the technique in the invention of JP'722 cannot prevent the vaporization of Mg after Mg starting material is added. As the evidence, the comparative examples 1 and 2 of the invention of JP' 722 show that 'Mg is decreased by 13.5% or more when the same Mg-Ni alloy is used as Mg starting material, as in the case of the invention of the application.

Due to the above, the invention of JP'722 is a completely different technique from that as claimed by Applicants and it is impossible for one having ordinary skill in the art to arrive at the

claimed subject matter based on JP'722 which does not have the technological thought of, preventing the dissipation of the vaporized Mg by controlling the furnace's power in terms of the inner furnace's pressure as an index and controlling the alloy melting temperature as 1250-1400°C.

Thus, Applicants' claimed subject matter permits the use of Mg metal and Mg<sub>2</sub>Ni which are economical and easily obtained. This is in contrast to JP' 722 where it is necessary to especially prepare REM-Mg alloy.

As noted in MPEP, Rev. 6, Sept. 2007, at 2100-130 (with bolded emphasis added):

Note that combining known prior art elements is not sufficient to render the claimed invention obvious if the results would not have been predictable to one of ordinary skill in the art. *United States v. Adams*, 383 U.S. 39, 51-52, 148 USPQ 479, 483-84 (1966). In *Adams*, the claimed invention was to a battery with one magnesium electrode and one cuprous chloride electrode that could be stored dry and activated by the addition of plain water or salt water. Although magnesium and cuprous chloride were individually known battery components, the Court concluded that the claimed battery was nonobvious. **The Court stated that “[d]espite the fact that each of the elements of the Adams battery was well known in the prior art, to combine them as did Adams required that a person reasonably skilled in the prior art must ignore” the teaching away of the prior art that such batteries were impractical and that water-activated batteries were successful only when combined with electrolytes detrimental to the use of magnesium electrodes. *Id.* at 42-43, 50-52, 148 USPQ at 480, 483. “When the prior art teaches away from combining certain known elements, discovery of successful means of combining them is more likely to be nonobvious.” *KSR*, 550 U.S. at \_\_\_, 82 USPQ2d at 1395.**

Paragraph [0009] of JP '722 specifically discloses “Means for Solving the Problem”, with “a manufacturing method of a hydrogen storing metal alloy of this invention Magnesium, In manufacturing a hydrogen storing metal alloy which uses nickel and a rare earth element as main composing elements, by adding a rare earth-magnesium system hardener to a nickel molten metal or



a rare earth-nickel series molten metal, It is characterized by preparing a rare earth-magnesium nickel series alloy of a request presentation.”

In fact, paragraph [0010] of JP ‘722 specifically states (with bolded emphasis added),

[0010]In a manufacturing method of a hydrogen storing metal alloy of this invention, as a hardener containing magnesium, Compared with the conventional magnesium nickel series hardener, **a rare earth-magnesium system hardener of a low melting point is used**, and a rare earth-magnesium nickel series alloy of a request presentation is prepared by adding this to a nickel molten metal or a rare earth-nickel series molten metal. Therefore, **since molten metal temperature at the time of dissolving a hardener containing magnesium can be lowered, a composition change by evaporation of magnesium can be controlled and it becomes possible to be stabilized and to control alloy composition easily**. Productivity in a volume production level can be improved.

Thus, JP ‘722 teaches away from Applicants’ claimed subject matter, and one having ordinary skill in the art would not have arrived at Applicants’ claimed subject matter.

Regarding the pressure in the melting furnace, the rejection once again admits that JP ‘722 does not disclose this feature, but contends that it would have been obvious to one having ordinary skill in the art based upon the method of JP ‘722 since the furnace is maintained in a vacuum state. However, Applicants again submit that JP ‘722 does not describe the pressure inside the furnace at the time of melting, but describes in examples melting of the rare earth-Mg system alloy that molten raw material is thrown in a crucible, and after carrying out full evacuation of the inside of a melting furnace, argon gas is introduced to 0.1 MPa (750 Torr) in the furnace for dissolution, see [0040] and [0046] of the specification. That is, JP ‘722 does not carry out melting under vacuum but under pressure of 0.1 MPa (750 Torr). In this connection, when Mg is melted under pressure of 0.1MPa (750 Torr), as understood from Fig. 1 of the specification of the present application, a molten bath temperature becomes not less than 1500°C and cannot prevent transpiration of Mg.

Moreover, the rejection uses the inherency language. However, the rejection does not support any inherency assertion with appropriate technical reasoning. Additionally, the Examiner is reminded that inherency must be a necessary result and not merely a possible result.

The features of Applicants' claims relating to pressure and temperature are not taught or suggested by JP '722, and further advantages associated with Applicants' recited process, as see, for examples, Applicants' specification beginning at the bottom of page 6. One having ordinary skill in the art would not have sought to arrive at these claimed features in JP '722 based upon the different intended method conditions associated with the method specifically disclosed by JP '722 including the explicitly disclosed use of **a rare earth-magnesium system hardener of a low melting point.**

Applicants once again submit that the obviousness rejection is using improper hindsight based upon Applicants' disclosure in an attempt to arrive at Applicants' claimed subject matter. However, one having ordinary skill in the art would not arrive at Applicants' claimed subject matter at least for the reasons set forth above.

Therefore, the rejections of record should be withdrawn, and the Notices of Allowance and Allowability should be mailed.

**CONCLUSION**

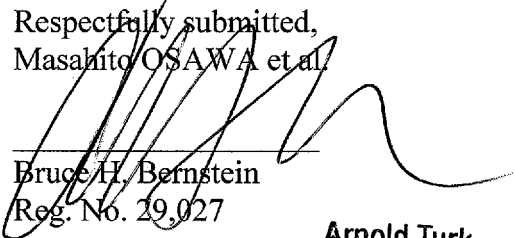
In view of the foregoing, the Examiner is respectfully requested to reconsider and withdraw the objection and rejections of record, and allow each of the pending claims.

Applicants therefore respectfully request that an early indication of allowance of the application be indicated by the mailing of the Notices of Allowance and Allowability.

Should the Examiner have any questions regarding this application, the Examiner is invited to contact the undersigned at the below-listed telephone number.

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